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Oviposition by the Mistletoe-feeding Pierid Butterfly *Mathania leucothea* (Mol.) in Chile

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Abstract. Oviposition by the Pierid butterfly *Mathania leucothea* was studied in the matorral zone of central Chile. Eggs were laid on *Tristerix tetrandus* (Loranthaceae), a common parasite of two Rosaceous shrubs. Several aspects of behavior contrast with earlier studies on crucifer- and legume-feeding Pierids. Eggs were deposited in batches, on young growing tissue. The eggs turn red soon after being laid. A high percentage (30.6%) of apparently suitable hosts bore at least one egg batch. Females appear to find *T. tetrandus* by searching visually for the Rosaceous hosts, and then inspecting these (possibly by olfaction) for the mistletoe.

Introduction

Pierid butterflies have been subjected to increasing scrutiny over the past 20 years, and have become an important group in the study of insect-hostplant relationships. Nearly all this attention has been directed at a few genera: the Pierini and Euchloini feeding on Cruciferae and other Capparales, and legume-feeding *Colias*. Few studies have reported on other species, particularly in dealing with the many large tropical genera which frequently associate with hosts of quite different growth form. Nothing is known, for instance, of the ecology of the very large mistletoe-feeding genus *Delias*. I report here observations on the butterfly *Mathania leucothea* Mol., which feeds on mistletoes (Loranthaceae) parasitic on trees. The results are of considerable interest for their comparison with studies on crucifer and legume-feeding pierids. The taxonomic position of *Mathania* is unclear, but is certainly close to *Hesperocharis*, which may be related to *Euchloini*.

M. leucothea is an endemic species of central Chile, living in forested and xerophytic-shrub (matorral) areas. In the summer-arid hills east of Santiago, the adults fly vigorously among the shrubs and trees, searching for mates, nectar or oviposition sites. The flight period is long (November to late February) in the austral summer. The butterfly is relatively common at mid-elevations on the west slope of the Andes in the province of Santiago. It was studied during early February 1984, females being watched as they searched for the larval hostplant, quintral, *Tristerix* (=

Phrygilanthus) *tetrandus* R. et Pav. (Loranthaceae). All observations were carried out between curvas 1 and 14 on the road below Farellones (1400 m); few individuals are seen above this area, although stragglers do occasionally reach Farellones itself at 2500 m. *T. tetrandus* infests two of the dominants of the scrubby woods: *Kageneckia oblonga* R. et Pav. ("Bollen" or "Hueyo") and *K. angustifolia* D. Don ("Olioitto") (Rosaceae). Foliage types are illustrated in Figure 1. The parasite is easily seen when in flower, when the bright red buds can be seen through the host foliage. *T. tetrandus* tends to grow in the center of the host, sprouting from the trunk or main branches; hence, it is not easily seen when just sprouting. Nine females were watched for a total of 3124 s as they searched various trees.

T. tetrandus plants were carefully examined for *M. leucothea* eggs and larvae. Interest centered on how the female butterflies find their host, how they deposit their eggs, and how intensive a grazing pressure they may exert on the host.

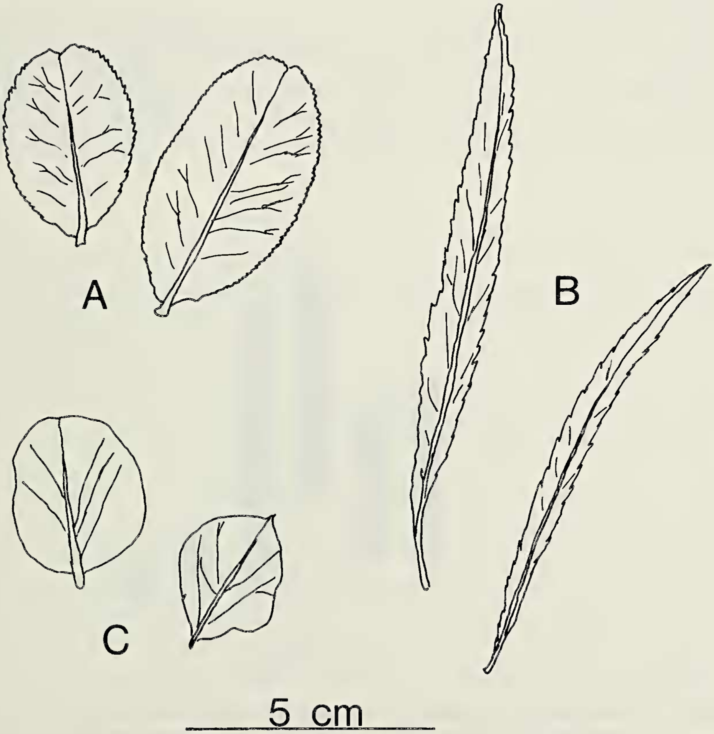

Fig. 1. Foliage shape in **a)** *Kageneckia oblonga*, **b)** *K. angustifolia*, **c)** *Tristerix tetrandus* (sketch from herbarium specimens).

Results and Observations

Female *M. leucothea* respond initially to the sight of either of the host trees of *T. tetrandus*, the female orienting from several meters away. Each tree is surveyed for parasitic growth, usually from outside the tree. If *T. tetrandus* is present, the female may enter deep among the tree's branches, and may spend a considerable time searching for an appropriate ovipopsition site (Table 1). The behavior suggests that olfaction plays a role in detection of the larval host since females almost never enter a tree unless *T. tetrandus* is present. Females persist in examining trees with *T. tetrandus*, even if they do not initially find the larval host. Females rarely land on the tree's foliage, but do so readily on *T. tetrandus*. Such contacts are transitory—only 9 of 143 (6.3%) led to oviposition. The female, after briefly touching the host, usually continues to fly around, presumably searching for a preferred oviposition site. Egg-laying is brief when it occurs: the wings fully closed (always open during "testing" contacts), the abdomen bent under, and one to several eggs rapidly deposited.

Eggs were only seen to be laid on *T. tristerix* growing on *K. oblonga*, although they were also found on the parasite on *K. angustifolia* when those were searched (Table 2). Females usually laid more than one egg per oviposition site (Fig. 2). Some species of Pieridae usually lay many eggs at one site (e.g., *Pieris brassicae, Ascia* and *Aporia* spp.), but few species lay

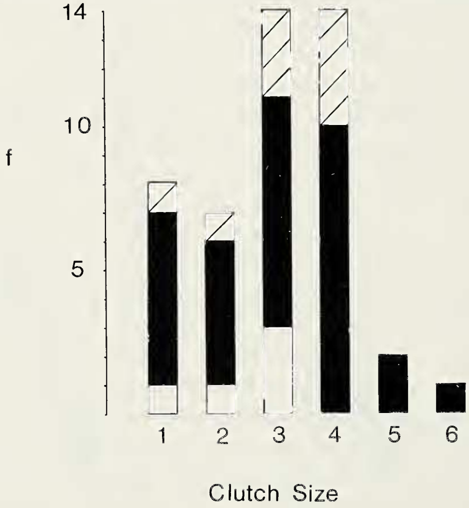

Fig. 2. The frequency of different clutch sizes in *M. leucothea*. Eggs found on *K. angustifolia* (open figure), *K. oblonga* (closed) and those laid by ovipositing females (hatched) are given. The latter were observed only on *K. oblonga*. Hatched eggs are excluded.

Table 1. The number of *Tristerix tetrandus* plants encountered by females, the mean time spent searching them (s), and the number of batches and of eggs deposited on hosts growing in the two species of *Kageneckia*. Significantly more time is spent surveying trees of either species when there is parasitic growth.
(*K. angustifolia* t = 7.32, P < 0.001)
(*K. oblonga* t = 4.98, P < 0.001)
More time is also spent scrutinizing *K. oblonga* foliage than on *K. angustofolia*.
(with *T. tetrandus* t = 5.90 P < 0.001)
(without *T. tetrandus* t = 0.68 N.S.)

	Kageneckia sp.	
	K. angustifolia	K. oblonga
No. of trees encountered		
with *T. tetrandus*	4	15
without *T. tetrandus*	17	36
Mean time spent searching trees (s)		
with *T. tetrandus*	46.0	102.7
without *T. tetrandus*	9.5	12.3
No. of batches laid	0	9
No. of eggs laid	0	28

batches of the sizes described here. *Pieris napi* L. (England) and *Colias vauthieri* (Chile) individuals may lay several eggs together if their respective hosts are rare (unpublished data), but *T. tetrandus* did not appear host limited during this study.

M. leucothea eggs are white when first laid, but turn red within a day or so, as in many other Pieridae. Shapiro (1981) linked red egg coloration to detection and deterrence of oviposition by other females. No evidence for or against Shapiro's hypothesis could be detected in this study. Note, however, that *T. tetrandus* plants appear large enough to support many larvae (though preferred tissues may be in short supply—see below); hence, there should be no competition among larvae or selection for deterrence of other females. Also, the presence of red eggs in a species taxonomically distant to those studied by Wiklund and Ahrberg (1978) and Shapiro (1981), suggests that the trait may be ancestral and may not reflect local adaptation at all; a similar view is put forward by Hayes (1985). This appears to be the first record of easily detected red eggs in a batch-laying species.

Oviposition was concentrated upon a very limited area of the host (Table 3) and white eggs were found only upon the youngest areas of growth. This finding suggests females chose apical growth, which may be better suited to larval growth. Among Pieridae, similar behavior has been noted in *Pieris rapae* L. (Jones et. al., 1982) and *Anthocharis cardamines* L. (Wiklund and Ahrberg, 1978). The preference for young growth leads to a clustering of batches upon *T. tetrandus* plants without flowers (Table 4); the resultant frequency distribution of batches on plants without flowers indicates strong clumping of batches (variance: mean ration = 8.85/1.21 = 7.31:1). Clumped egg distributions occur in a large number of pierid species (reviwed by Courtney and Courtney, 1982); such distributions can result from butterflies tending to discover the same hosts—these are the first data suggesting that choice of oviposition sites also causes clumping.

Miscellaneous Observations

1. On two occasions females were seen to "interact" with each other in the manner of courting males. In both cases one of the females, which had discovered a host-plant, appeared to chase the other (A. M. Shapiro observed similar behavior in *Danaus plexippus* [L]). Since 22 of 72 (30.6%) of apparently suitable *T. tetrandus* shoots bore eggs, it is suggested that optimal host oviposition substrate may be limited. Red eggs, quasi-territoriality and batch oviposition by females might thus all be linked to low availability of host material.

Table 2. The numbers of *T. tetrandus* plants, and of *M. leucothea* batches and eggs found in a sample of *Kageneckia* trees. Trees were sampled by walking from curva 3 up the road to Farellones, examining every tree adjacent to the road; sampling ceased when 100 *K. oblonga* plants had been examined. *K. angustifolia* plants are less often infested by *T. tetrandus* and the parasites growing in that host are less often attacked by *M. leucothea* (hatched eggs are not included here).

	Kageneckia sp.	
	K. angustifolia	*K. oblonga*
No. of trees discovered		
with *T. tetrandus*	6	31
without *T. tetrandus*	29	69
No. of *T. tetrandus*	7	39
No. of *T. tetrandus* with eggs	3	21
Mean No. of *M. leucothea* eggs per *T. tetrandus* plant	1.7	2.5
per plant with eggs	4.0	4.6

Table 3. The distribution of *M. leucothea* eggs of different color stages and ages, upon different tissues of *T. tetrandus*.

	Number of eggs			Number of batches
	white	red	hatched	
Open flowers	—	—	—	—
Closed flowers	——	1	—	1
Stems and leaves > 10 cm from apex	—	55	64	41
Stems and leaves < 10 cm from apex	—	17	18	12
Apical stems and leaves	23	7	—	13

Table 4. The effect of *T. tetrandus* age status upon *M. leucothea* oviposition.

Status of *T. tetrandus*	No. of Plants	No. of Plants with Eggs	No. of Batches
> 20% of flowers open	10	0	0
< 20% of flowers open	7	2	2
No flowers open	29	22	35

2. Less time was spent by females searching *K. angustifolia* than *K. oblonga* (Table 1). This may reflect the similarity between the foliage of *T. tetrandus* and *K. oblonga*, although *K. angustifolia* trees are also often small, requiring less search time. One female was of particular interest: having oviposited on *T. tetrandus* in a *K. oblonga* tree, she then immediately discovered two *K. angustifolia* and one *K. oblonga* growing tangled together. Only 13 s were spent searching *K. angustifolia* foliage but 98 s in *K. oblonga* (*T. tetrandus* was not present on any of the trees) and the female persistently returned to the latter foliage. This may indicate a short-term learning effect, as shown in other butterflies (Stanton, 1983; Papaj and Rausher, 1983).

3. *T. tetrandus* plants were very heavily attacked by several herbivores, including a batch-laying moth. Many ants and lacewing larvae (potential predators) were also seen. Survival of *M. leucothea* appeared very poor: only 11 of 32 (13.4%) of hatched eggs still had a larva nearby. Despite apparent poor early instar of survival by *M. leucothea*, the effect of butterfly grazing on the plant may be disproportionate to the amount of tissue consumed, since grazing is concentrated on young tissues.

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